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AMSAT's Newsletter for the Amateur Radio Space Program

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Brain Surgery Success! AO-10 Returns To Service

Recovery efforts aimed at restoring AMSAT OSCAR 10 to service met success July 15th when the Mode B transponder was enabled for limited use. This favorable development capped two months of intensive work by spacecraft engineers and controllers. It marked the culmination of a process of subtle diagnostic testing, re-writing the IHU software and cautious evaluation of the results.

AO-10's computer memory had been showing evidence of accumulating radiation damage for nearly a year. The error correcting software "hit" counter had been incrementing regularly. Last Autumn the first major "hard" failure became evident. But the software was able to accommodate it. On May 17th the quantity and location of errors in the IHU memory overwhelmed the error correction mechanism and caused the operating system to "crash". This took AO-10 off the air in what most users considered an unexpected shock.

At the time the situation looked bleak; controllers were able only to reset the IHU with the master reset command. Ominously, they were unable to gain a foothold in reloading the IPS operating system.

Karl Meinzer, DJ4ZC, the principal architect of the IPS operating system, designed a memory diagnostic package which produced a memory map of the failed and marginal memory cells. The memory map proved to be a veritable road map to AO-10 recovery. Based on this chart of the affected memory areas, Karl was able to rewrite the IPS operating system so as to avoid the affected zones. To reduce the probability of errors from marginal areas, the refresh cycle was shortened too. Ian Ashley, ZL1AOX, working with Karl, soon reported the new IPS-C4 package seemed to be working. The IHU wasn't crashing as it had been.

By about July 12, the decision had been made to turn on Mode B beginning July 15th. This was done with a reduced operating schedule put into effect. That schedule was replaced by a more liberal one. At press time the new AO-10 schedule was:

Mode B MA 075 thru 119
Mode L MA 120 thru 136
Mode B MA 137 thru 180
Off MA 181 thru 074

ZL1AOX reoriented the satellite beginning July 16 and continuing through about July 21st. This will prepare the satellite for seasonal changes in sun angles and insure proper orientation. Had this reorientation not been accomplished using the new IPS-C4, by late summer AO-10 would have been in very dire straights due to reduced sun angle and consequent reduced electrical energy. The attitude was estimated at LON 184, LAT -2. QRP operation is strongly recommended.

The overall situation on AO-10 is now stable and generally favorable. Following re-orientation an increased operating schedule may be implemented. However, due to the reduced memory capacity, it will no longer be possible to support the CW and RTTY telemetry sections of telemetry. Bulletins henceforth will be send in PSK "M" blocks.

The Amateur satellite community welcomed the news of AO-10's return with broad applause and admiration for the superb efforts of those who first fathomed the problem and then applied the highest skills in developing work-around methods. AMSAT congratulates all those who worked the problem and in particular DJ4ZC and ZL1AOX for their brilliant work! Thanks also go to WØPN, KA9Q, WD4FAB, W2FPY, W3GEY.

JAS-1 Launch Slips To August

AMSAT will provide an AMSAT Launch Information Network Service (ALINS) operation for the launch of JAS-1, the Japanese Amateur Radio League (JARL) satellite. The launch is currently scheduled for Thursday 07 August at 2030 UTC.

ALINS will feature three phases:

Phase 1: Pre-launch advisories and nets
Phase 2: Realtime launch and separation coverage
Phase 3: Post-launch advisories and nets.

During phase 1, WEEKLY ADVISORIES will be sent by JA1ANG on Fridays (U.S. time) through 01 August. They will be transferred to Telemail for inclusion in the AMSAT News Service weekly releases. The weekly advisories will be included in all AMSAT net operations.

In the days leading up to launch, the reporting pace will quicken. DAILY ADVISORIES will be sent by JA1ANG starting Tuesday, 05 August and continuing to launch day, Thursday 07 August. They will be transferred to Telemail

by WØRPK as soon as possible to allow for timely dissemination.

A special 75 meter AMSAT net cycle will be held on Wednesday 06 August. The 75 meter frequency is 3857 kHz.

ALINS Phase 2 provides REALTIME launch coverage beginning on launch day, 07 August (U.S. time). Coverage will start with hf net check-ins at 1930 UTC. Teleconference linking of all net stations will begin at 2000 UTC. Nets will be active on 20 and 40 meters. Frequencies planned for use include 14282, 14295, 7185 and, if 15 meters is open, 21390 kHz. JA1ANG in Japan will be included in the teleconference to provide a first-hand description of launch and boost phases.

Teleconference and net operations will continue with separation and first beacon reports from South America at 2132 UTC. These reports and a wrap-up of events will conclude the realtime coverage at 2200 UTC.

ALINS Phase 3 provides POST-LAUNCH ADVISORIES sent by JA1ANG on Friday and Saturday (August 8th and 9th) as necessary. Special 75 meter AMSAT net sessions will be held on Thursday and Friday evenings to distribute Keplerian elements, satellite information and to recap launch coverage.

The following is the 18JUL86 JAS-1 pre-launch advisory from Haruo Yoneda, JA1ANG, and Ralph Wallio, WØRPK. The next JAS-1 ALINS advisory is due 25JUL86.

"The Japanese Amateur Radio League (JARL) JAS-1 OSCAR satellite has been rescheduled for launch on 07AUG86 at 2030UTC. Japan's H-1 launch vehicle will lift off from the Tanegashima Space Center off the coast of South Kyushu located at 30.396 degrees North latitude and 229.027 degrees West longitude.

"This is TEST FLIGHT #1 (TF-1) for NASDA's two-stage H-1 vehicle. In addition to JAS-1, it will carry a payload called EGP (orbiting mirror ball) and a payload called MB FW (magnetic bearing fly-wheel).

"The 07AUG86 launch window will be from 2030 to 2200UTC. Later windows, if required, will occur from 08AUG86 thru 14SEP86. However, the dates 20AUG86 thru 26AUG86 and 06SEP86 thru 14SEP86 are reserved for Institute of Space Research launches."

Following is a revised set of Keplerian elements with an epoch of separation time (assuming a nominal lift off):

Ref Epoch:	86 219.897306 UTC
Inclination:	50.004 deg
RAAN:	244.3507 deg
Eccentricity:	0.0001407
Arg. of Per:	2.155 deg
Mean Anomaly:	330.246 deg
Mean Motion:	12.412719 rev/day
Decay:	0 rev/day/day
Epoch Rev:	0
SMA	7879.56 km
Beacon:	435.795 MHz

Following is the TF-1 sequence of events after lift off. The launch vehicle will, at event #20, be in an elliptical orbit with an apogee of 1511 Km and perigee of 271 Km. The second burn of the second stage at event #27 will circularize the orbit at 1503 Km. The JARL JAS-1 OSCAR satellite will separate at event #34 and immediately turn on its 435.795 MHz 20WPM CW modulated beacon."

SEQ	EVENT DESCRIPTION	HH MM SS	RANGE	ALT	VEL
1	LIFT OFF	00 00 00	0	0	0.4
2	Start - roll program	00 00 03			
3	End - roll program	00 00 08			
4	Start - roll/pitch/yaw program	00 00 08			
5	End of burn - 6 solid fuel boosters	00 00 39	0.8	5	0.5
6	Ignition -- 3 solid fuel boosters	00 00 40			
7	End of burn - 3 solid fuel boosters	00 01 19	8	18	0.8
8	Separation - 9 solid fuel boosters	00 01 28			
9	End - roll/yaw program	00 01 31			
10	End - pitch program	00 04 18			
11	End of burn - main engine	00 04 30	301	111	4.0
12	End of burn - vernier engine	00 04 36			
13	Separation - 1st stage	00 04 38	329	119	
14	IGNITION - 1ST BURN OF 2ND STAGE	00 04 42			
15	Separation - fairing	00 04 54	387	134	
16	Start - roll/yaw program	00 05 00			
17	End - roll/yaw program	00 05 50			
18	Start - pitch program	00 05 50			
19	End - pitch program	00 10 08			
20	END - 1ST BURN OF 2ND STAGE	00 10 14	1992	342	8.0
21	Start - inertial flight pitch program	00 10 46			
22	End - inertial flight pitch program	00 13 16			
23	Start - inertial flight yaw program	00 13 16			
24	End - inertial flight yaw program	00 14 16			
25	Start - inertial flight roll program	00 14 16			
26	End - inertial flight roll program	00 14 46			
27	IGNITION - 2ND BURN OF 2ND STAGE	00 54 33	17831	1508	6.8
28	END - 2ND BURN OF 2ND STAGE	00 54 54	17930	1507	7.1
29	Start - inertial flight roll/pitch program	00 55 44			
30	End - inertial flight roll/pitch program	00 57 14			
31	Separation - EGP payload	00 59 21	18955	1505	7.1
32	Start - inertial flight yaw program	01 00 27			
33	End - inertial flight yaw program	01 01 17			
34	SEPARATION - JAS-1 PAYLOAD	01 02 07	21161	1503	7.1
35	Switch on - experimental flywheel	01 02 08			
36	Start - inertial flight roll/pitch program	01 02 47			
37	End - inertial flight roll/pitch program	01 04 02			
38	Change attitude - 2nd stage to vertical				
39	End - 2nd stage control				

SEQ Event sequence
HH MM SS Hours Minutes seconds after liftoff
RANGE From launch site in Km
ALT Altitude in Km
VEL Velocity in Km/s

Mir Cosmonauts Return Safely To Earth

The two Russian Cosmonauts, Leonid Kizim and Vladimir Solovev, returned safely to earth Wednesday, July 15th after a 126 day mission. During that time they placed the new Russian space station, Mir, in commission. They also performed much needed repairs on the aged Salyut-7 space station.

Solovev and Kizim were launched into orbit March 13 aboard a Soyuz T-15 vehicle; the same unit they used to return to earth on July 15th. Besides extensive extra-vehicular activity, the Cosmonauts accomplished the first-ever vehicle-to-vehicle transfer in space when they first moved from Soyuz T-15 to Mir and later used the Soyuz to move to Salyut-7. Later they returned to Mir again using Soyuz T-15.

With the completion of this mission, Cosmonaut Kizim has spent more than a year in orbit counting his previous space missions. In 1984 Kizim, Solovev and Oleg Atkov set an endurance record by spending 237 days in orbit.

It now appears Salyut-7 will be preserved in orbit. Earlier reports in East German newspapers had the Salyut-7 being de-orbited by mid-July apparently having exceeded its usefulness. Now however, there are indications Salyut-7 will continue in orbit as a storehouse or warehouse for the next and succeeding missions. It is understood more modules will soon be launched and docked to Mir. Eventually the assembly will exceed 100 tons and 150 cubic meters.

Bouncing Packets Off the Moon and Related Lunacy

by TOM CLARK, W3IWI

Recently I attempted bouncing packets off the moon during the W3IWI/KL7RA 432 MHz EME outing using the 26m (85') diameter dish at Gilmore Creek, near Fairbanks, Alaska. Previously I had tried EME packets using the 43m (140') dish at Greenbank, West Virginia and the 26m Alaskan dish. Both earlier attempts were total "wipeouts" at 1200 baud due to the severe multipath conditions that arise because the moon is a "rough" scattering surface.

This year I decided to try the new AEA PM-1 HF packet modem with 200 and 600 Hz shift FSK. The PM-1 employs separate filters and square-law detectors for the high and low FSK tones and hence is close to being an optimum detector for paths with lots of fading. This operated with a stock TAPR TNC2.

The 26m dish was measured to have 38 dBi gain. Due to mechanical limits, we were only able to use a QRP (by EME standards) transmitter...about 140 watts output from a solid-state power amplifier (Mirage D1010N) located at the dish's prime-focus feed-point. Therefore, this gave us about 700 kW EIRP squirted at the moon. The receiver used a GaAsFET preamp (at the feed) driving a converter and a TS-830. The transmitter exciter was an FT-726. The feed consisted of crossed-dipoles a quarter-wave above a ground plane for selectable linear polarization.

The round-trip travel time to the moon is about 2.2 seconds. We did the EME packet tests at a time when the Doppler shift was small so that our receiver copied the out-going packet and then its return after reflection from the moon. The following are a few of the time-stamped beacons showing both the "direct" and reflected signals (note the 2 or 3 second difference in the time stamps):

W3IWI>CQ [06/29/86 13:02:26]:W3IWI/KL7 test
W3IWI>CQ [06/29/86 13:02:28]:W3IWI/KL7 test

W3IWI>MOON [06/29/86 15:19:46]:W3IWI/KL7 EME Packet Test
W3IWI>MOON [06/29/86 15:19:49]:W3IWI/KL7 EME Packet Test

W3IWI>MOON [06/29/86 15:21:16]:W3IWI/KL7 EME Packet Test
W3IWI>MOON [06/29/86 15:21:18]:W3IWI/KL7 EME Packet Test

W3IWI>MOON [06/29/86 15:22:16]:W3IWI/KL7 EME Packet Test
W3IWI>MOON [06/29/86 15:22:19]:W3IWI/KL7 EME Packet Test

I found that at 200 Hz shift, the incoherent fading still rendered most packets unreadible. This was quite apparent from just looking at the PM- 1's LED tuning indicator. I also tried the 600 Hz shift mode on the PM-1 and was totally unsuccessful.

We had hoped to make 2-way packet QSO's during this EME outing. The team of XE1XA/XE1TU in Mexico City and VE7BBG in Vancouver were QRV but signals were too weak and fluttery to attempt a packet QSO.

Our 432 MHz operations spanned three days — 28, 29 and 30 June. During that period we managed 29 QSO's with 19 stations. Of these 9 were stations we had not worked during previous W3IWI/KL7RA operations. We were very disappointed in the overall lack of activity. Only one European (OK1KIR) was on the air and we heard nothing from South America, Asia or Oceania or Africa. This lack of activity [which resulted in a lack of enthusiasm on our part to be masochists just to meet a 3 AM local moonrise, only to hear our own echos very loud and have nobody to work!], coupled with other station activities, caused us to reduce our planned operation window and terminate on the 30th of June (instead of going thru July 4th as we had originally planned).

The 19 stations we worked during the June 1986 session were:

N9AB	!K5JL	WØHHE	!*KD6R	!*VE7BBG	!*W6XJ
W1ZX	*WA5ETV	W1JR	*XE1XA	*XE1TU	*WBØYSG
N7ART	OK1KIR	K1RQG	*AD1C	WØRAP	*N4EL
W8IDU					

where the * denotes stations not previously worked by either W3IWI/KL7 or KL7RA, and ! indicates a successful 2-way SSB QSO. In addition weak signals were detected from W5NZX.

We also experimented using a 256 channel FFT (Fast Fourier Transform) spectrum analyzer (HP 3582A) monitoring either a 10 or 25 kHz chunk of spectrum and found that it would spot a weak station before we would acquire it by "earball" with the narrow CW filter on the TS830. Playing with this new "toy'" helped greatly to alleviate the boredom caused by having so few stations on the air. In the case of the weak signals from W5NZX which would have been marginal "M" copy, the FFT box was able to obtain a S/N of 10-15 dB with suitable time-averaging and we were able to measure his received frequency to an accuracy of < 10 Hz. It seems to me that it is now time to begin developing digital signal processing techniques for weak signal VHF/UHF/microwave work.

On July 9th, we had a bit of a thrill when we played SWL and ran a one-way sked with Paul Wilson, W4HHK on 2304 MHz EME. Paul was able to poke about 150 watts of S-band rf into his fabled dish and we had solid 569 copy for well over an hour interrupted only by Paul tripping the circuit breaker on his transmitter.

Symposium Tapes Available At Video Tape Library

Tom Larson, N1CHM, AMSAT Video Tape Library Manager, reminds AMSAT members that materials from the library are appropriate for showing at club meetings and various events where amateurs gather. The tapes included in the library include recent ones on JAS-1, the Phase 3C RUDAK transponder and the Mode S transponder.

According to Tom, these are the most recent additions to the library catalog:

Tape #15: SAREX: The Shuttle Amateur Radio Experiment. Tony England's STS-51F flight featuring SSTV. Produced by ARRL. VHS. 30 minutes.

Tape #16: 1985 AMSAT Space Symposium, Part 1. The Future of AMSAT. Beyond Phase 3C: a discussion of Phase 3D, Phase 4 and future funding.

Tape #17: 1985 AMSAT Space Symposium, Part 2. Digital satellites. Survey of current and planned digital transponders aboard amateur satellites. Report on JAS-1. The RUDAK transponder. The SAREX-2 proposal.

Tape #18: 1985 AMSAT Space Symposium, Part 3. Developing Technologies. ACSSB. Satellite Gateway Concepts. OSCAR-10 eclipses. The Mode S transponder aboard Phase 3C. Patch antennas. ARTOB, Amateur Radio Transponders on Balloons.

The complete AMSAT Video Tape Library catalog plus an ouline of library procedures may be obtained for a business sized SASE to: Tom Larson, N1CHM, AMSAT Video Tape Library, 85 Main Street, Dover, MA, 02030

MARCE Awards Readied

The highly successful Marshall Amateur Radio Club Experiment, MARCE, was part of the space shuttle Columbia mission launched January 12. (The last shuttle mission prior to the Challenger disaster). Dozens of stations actually heard and recorded the MARCE telemetry direct from the MARCE GAS can (Getaway special can) on 70 cm. A very special few actually heard the telemetry as relayed through AO-10, Mode B. And one station, KG6DX, had enough MARCE signal through AO-10 to actually have FM capture and demodulation of the synthesized voice telemetry! Now the awards for these MARCE telemetry trackers are being readied for distribution. And we have a more complete list of those participating in southern Africa. They are: ZR6JJ, ZR1L, 5Z4EG, ZS6KM, ZS6BTD, ZS6AJT, ZS6IM, ZS6BWW, ZS6KE, ZS6HS, ZS6AKV. Thanks again to all from AMSAT and the MARCE/Pioneer Project!

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